

Shellfish Action Plan

Strangford Lough (Skate Rock, Marlfield Bay & Paddy's Point, Reagh Bay)

December 2019



Department of
**Agriculture, Environment
and Rural Affairs**

www.daera-ni.gov.uk



**INVESTORS
IN PEOPLE**

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1.0 Introduction

Pollution Reduction Programmes (now Shellfish Action Plans) were established under Article 5 of the Shellfish Waters Directive (2006/113/EC) which stated that all Member States should establish programmes in order to reduce pollution in designated shellfish waters. Shellfish Action Plans will next be reviewed on a priority basis starting in 2021 which is in line with the third River Basin Cycle under the Water Framework Directive.

The Shellfish Waters Directive was subsumed into the Water Framework Directive (2000/60/EC) in December 2013. Since then all shellfish waters are protected under the Water Framework Directive (WFD) and are hereafter referred to as Shellfish Water Protected Areas. Shellfish Water Protected Areas are afforded the same level of protection under WFD as they were under the Shellfish Waters Directive. The Department will continue to work to deliver effective management of Shellfish Water Protected Areas through the UK's post Brexit Marine Strategy.

Skate Rock and Marlfield Bay were designated in 1999, whilst Paddy's Point and Reagh Bay were designated in 1983 by administrative means. The shellfish waters were realigned in 2009 and there are currently four production areas licensed by Department of Agriculture Environment and Rural Affairs (DAERA) Marine and Fisheries Division within the three Shellfish Water Protected Areas in Strangford Lough. Although there are currently four production areas, Marlfield Bay has not been involved in any shellfish harvesting since 2014. Should this situation continue, the Department will consider the de-designation of the Shellfish Water Protected Area.

There are also eight sites licensed by DAERA which are outside the Shellfish Water Protected Areas.

Classification by the Food Standards Agency in NI has consistently been of an A or B class.

2.0 Description of catchment

Strangford Lough is located south of Newtownards and east of Downpatrick. It lies within the North Eastern River Basin District which covers a catchment area of approximately 885km². The main rivers entering the Lough are the Comber River in the northwest and the Quoile River in the southwest. Numerous smaller rivers and streams exist throughout the area, all entering Strangford Lough at various points.

Strangford Lough itself is a large shallow sea lough approximately 24km long, 8km wide and 66m deep at its deepest point. However much of the Lough is less than 20m deep. The Lough has an indented shoreline that contains extensive areas of mudflats, sand flats, salt marshes as well as a rocky coastline. It is one of the most important marine sites within Europe and is designated as both a Natura 2000 site and as a Marine Protected Area under the Marine (Northern Ireland) Act, 2013. There are a number of additional designations giving protection to the environmental features of this unique area.

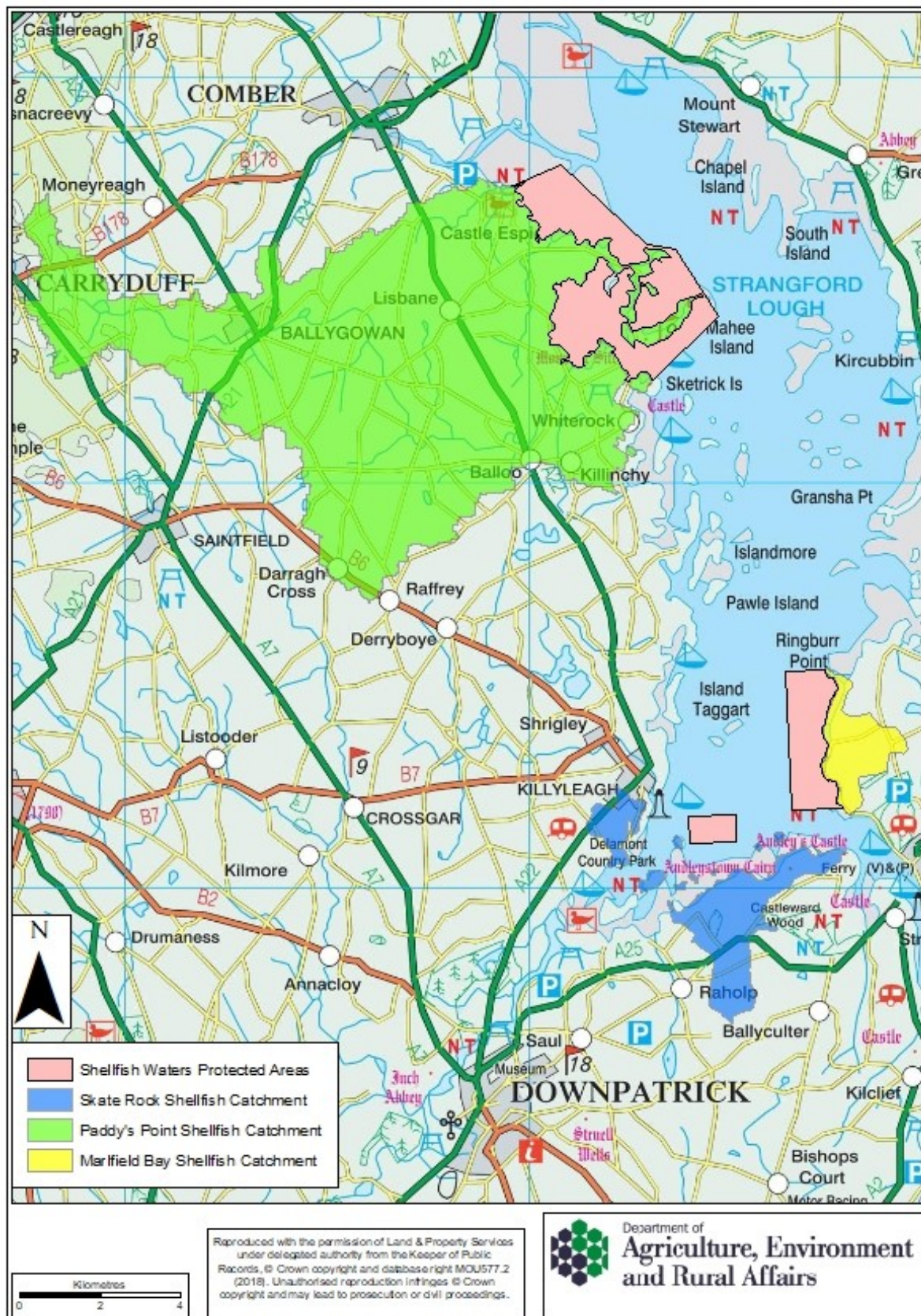
In addition to being a Shellfish Water Protected Area, it is an area of Outstanding Natural Beauty (AONB) and supports a wide range of recreational activities including walking, sailing, diving and tourism.

The 2011 Sanitary Survey¹ reports that land usage in the catchment is approximately 90% agricultural land (pastures, complex cultivation patterns and agriculture/natural vegetation). The main settlements in the catchment include Newtownards, Dundonald, Comber and Downpatrick. There are also numerous smaller towns and villages scattered throughout the area.

The main pollution sources in Strangford Lough come from continuous and intermittent discharges throughout the lough. Of the discharges flowing into Strangford Lough, Ballyrickard Wastewater Treatment Works (WWTW) (located in the north-western region of the Lough) has the highest discharge volume. There are also various other non-point pollution sources associated with agricultural land use, tourism and wildfowl.

¹ <https://www.food.gov.uk/sites/default/files/media/document/strangfordLough.pdf>

Figure 1. River Catchment Areas Draining into Strangford Lough



3.0 Objectives for Shellfish Water Protected Areas

Under WFD, all Shellfish Water Protected Areas (SWPAs) must be managed to ensure that they meet their ecological and chemical objectives under WFD **AND** meet at least Class B status under the EU Hygiene Regulations. SWPAs must also make progress towards the WFD microbiological guideline standard of $\geq 75\%$ of samples contain ≤ 230 *E.coli* in the shellfish flesh and intervalvular liquid². The Food Standards Agency in NI is responsible for the implementation of classification and monitoring programmes for shellfish for the protection of public health.

3.1 Water Framework Directive status and shellfish classification

Comprehensive monitoring programmes are in place to assess the status of Shellfish Water Protected Areas under the WFD and classification under the EU Hygiene Regulations. A suite of determinands is assessed to determine ecological status and the overall objective under WFD. Skate Rock and Marlfield Bay lie within Strangford Lough South water body whilst Paddy's Point and Reagh Bay lie within Strangford Lough North water body. Tables 1 & 2 show the future WFD ecological objective for Strangford Lough North and South water bodies.

Table 1. WFD Ecological Status and Objectives for Strangford Lough North

2021 Objective	2027 Objective
Good Ecological Status & Class B under EU Hygiene Regulations	Good Ecological Status & Class B under EU Hygiene Regulations

² <http://www.legislation.gov.uk/nisr/2015/351/contents/made>

Table 2. WFD Ecological Status and Objectives for Strangford Lough South

2021 Objective	2027 Objective
Moderate Ecological Status & Class B under EU Hygiene Regulations	Good Ecological Status & Class B under EU Hygiene Regulations

Table 3 shows the Classification status at Skate Rock, Marfield Bay and Paddy’s Point and Reagh Bay under WFD (colour) and the licensed shellfish beds under the EU Hygiene Regulations (text).

Table 3. Classification status of shellfish production areas in Skate Rock, Marfield Bay & Paddy’s Point and Reagh Bay

	2018	2017	2016	2015	2014	2013
Skate Rock (Mussels)(AFFNI 42 – S2)	A	A	A Provisional	A	A Provisional	A Provisional
Marfield Bay (Scallops) (AFFNI 43 – S23)	N/P	N/P	N/P	N/P	B	B
Paddy’s Point (Oysters)(AFFNI 76 – S7) Reagh Bay (Oysters) (AFFNI 93 – S6)	B	B	B	B	A Provisional	A ** Provisional
Paddy’s Point (Mussels) (AFFNI 76 – S7)	B	B	B	B	A Provisional	A Provisional

A provisional classification is given when a new bed is classified based on a limited number of samples or when a bed is borderline compliant with criteria of a classification.

Key to WFD Status

High	
Good	Good Ecological Potential
Moderate	Moderate Ecological Potential
Poor	Poor Ecological Potential
Bad	Bad Ecological Potential

4.0 Monitoring programmes for Shellfish Water Protected Areas and shellfish flesh

4.1 Monitoring of *E. coli* in shellfish flesh

FSA conducts monthly analysis of *E. coli* in shellfish flesh as part of its Official Control monitoring. This analysis is used to classify the quality of shellfish production areas. The classification determines the level of post-harvest treatment required before placing shellfish product from that area on the market. The FSA in NI's Official Control monitoring programme is solely for the purpose of classification of shellfish production areas. It is not intended as an indication of the end product standard of shellfish. Responsibility for ensuring the safety of shellfish which are placed on the market for human consumption rests solely with the food business operator (FBO)³.

Table 4. Shellfish classification and post-harvest treatment

Classification of harvesting areas		
Category	E.coli per 100g flesh and intravalvular liquid	Post-harvest treatment required
A	≤230	May go directly for human consumption if end product standard met.
B	90% results <4600 Remaining 10% results <46000 100% results <46000	Must be subject to purification or cooked by an approved method.

³<https://www.food.gov.uk/business-guidance/biotxin-and-phytoplankton-monitoring>

Classification of harvesting areas		
Category	E.coli per 100g flesh and intravalvular liquid	Post-harvest treatment required
C	<46,000	Must be subject to relaying for a period of at least 2 months or cooked by an approved method.
	>46,000 E.coli/100g of flesh	Prohibited. Harvesting not permitted.

4.2 Producer responsibility

Shellfish producers and harvesters have obligations under the EU Hygiene Regulations to ensure the quality of the product which they place on the market for human consumption. Producers should have an understanding and awareness of the environment in which product is being produced. Producers should use where possible, their own testing regimes to inform business management decisions. It is acknowledged that in order to make sound decisions, producers need access to appropriate and timely information relating to the quality of the shellfish water and anything which has the potential to impact upon it.

4.3 Guideline microbiological standard (DAERA)

The shellfish flesh monitoring programme is operated by FSA in NI. The analyses in shellfish flesh are carried out by Northern Ireland Public Health Laboratories and results are reported back to both DAERA and FSA in NI.

In addition to being used for the Official Control monitoring for the microbiological shellfish classification carried out by the FSA in NI, this information is also used by DAERA to determine the status of Shellfish Water Protected Areas against a guideline microbiological standard for shellfish flesh which is set in the Water Framework Directive (Priority Substances and Classification) (Amendment) Regulations (Northern Ireland) 2015. This guideline standard requires that 75% of samples contain ≤ 230 *E. coli* per 100ml of shellfish flesh and intervalvular liquid.

Table 5. shows the status of Skate Rock, Marfield Bay and Paddy’s Point/Reagh Bay against the WFD Guideline standard.

Shellfish Water Protected Area	2018	2017	2016	2015	2014	2013
<i>Skate Rock</i>						
Total Number of Samples	13	14	12	12	13	12
% Samples Meeting Guideline	92	93	100	92	100	100
<i>Marfield Bay</i>	N/A	N/A	N/A	N/A	N/A	
Total Number of Samples	0	0	0	0	0	11
% Samples Meeting Guideline	N/A	N/A	N/A	N/A	N/A	100
<i>Paddy’s Point/Reagh Bay</i>						
Total Number of Samples	25	26	26	25	24	12
% Samples Meeting Guideline	64	77	81	72	83	100

	Met Guideline
	Did Not Meet Guideline

4.4 Monitoring of contaminants in shellfish flesh

Annual analysis of a suite of contaminants in shellfish flesh is carried out in all seven of the sea loughs/areas in Northern Ireland in which shellfish are cultivated and harvested. This is a joint programme of monitoring currently in place with FSA in NI and DAERA to meet both organisations’ requirements under EU legislative requirements and OSPAR (Oslo/Paris Convention (*for the Protection of the Marine Environment of the North-East Atlantic*)) and to enable DAERA to determine

compliance with a range of environmental obligations relating to Shellfish Water Protected Areas.

The suite of contaminants tested for includes trace metals, lipids, dioxins, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). See Annex A.

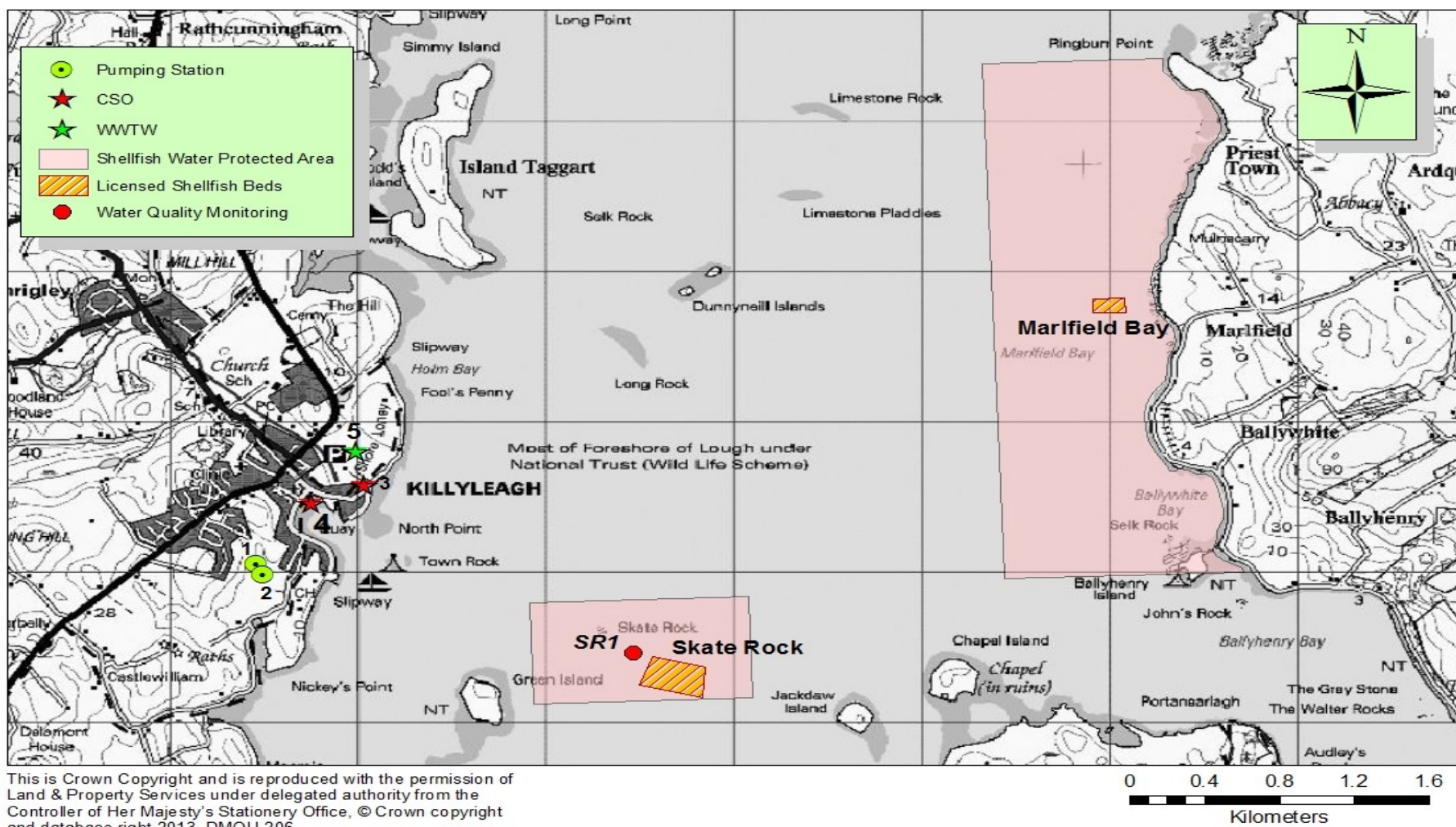
4.5 Investigative monitoring (DAERA)

Where Shellfish Water Protected Areas are at risk of failing to meet objectives, specific investigative monitoring is undertaken of the protected areas, rivers and any other potential sources of pollution identified.

In addition to the measures set out in this Shellfish Action Plan, DAERA will investigate any pollution incident and/or deterioration in water quality. Formal arrangements are in place between DAERA, NI Water and the FSA in NI to investigate and respond to incidents relating to water quality at Shellfish Water Protected Areas. This includes responding to requests for investigation of FSA in NI microbiological official control sample results which are outwith the classification of the shellfish production area and any pollution incident in the proximity of a Shellfish Water Protected Area.

It is an offence under the terms of the Water (Northern Ireland) Order 1999 to cause pollution to a waterway. Pollution incidents will be investigated in accordance with the DAERA Enforcement and Prosecution Policy, which can be found at; <https://www.daera-ni.gov.uk/sites/default/files/publications/daera/emfg-enforcement-policy.pdf>

Figure 1. Licensed shellfish production areas in Skate Rock & Marfield Bay, showing water sampling points, Shellfish Water Protected Area and potential point pollution sources.



Key – Skate Rock

1: Inishmore Wastewater Pumping Station

2: The Moorings Wastewater Pumping Station

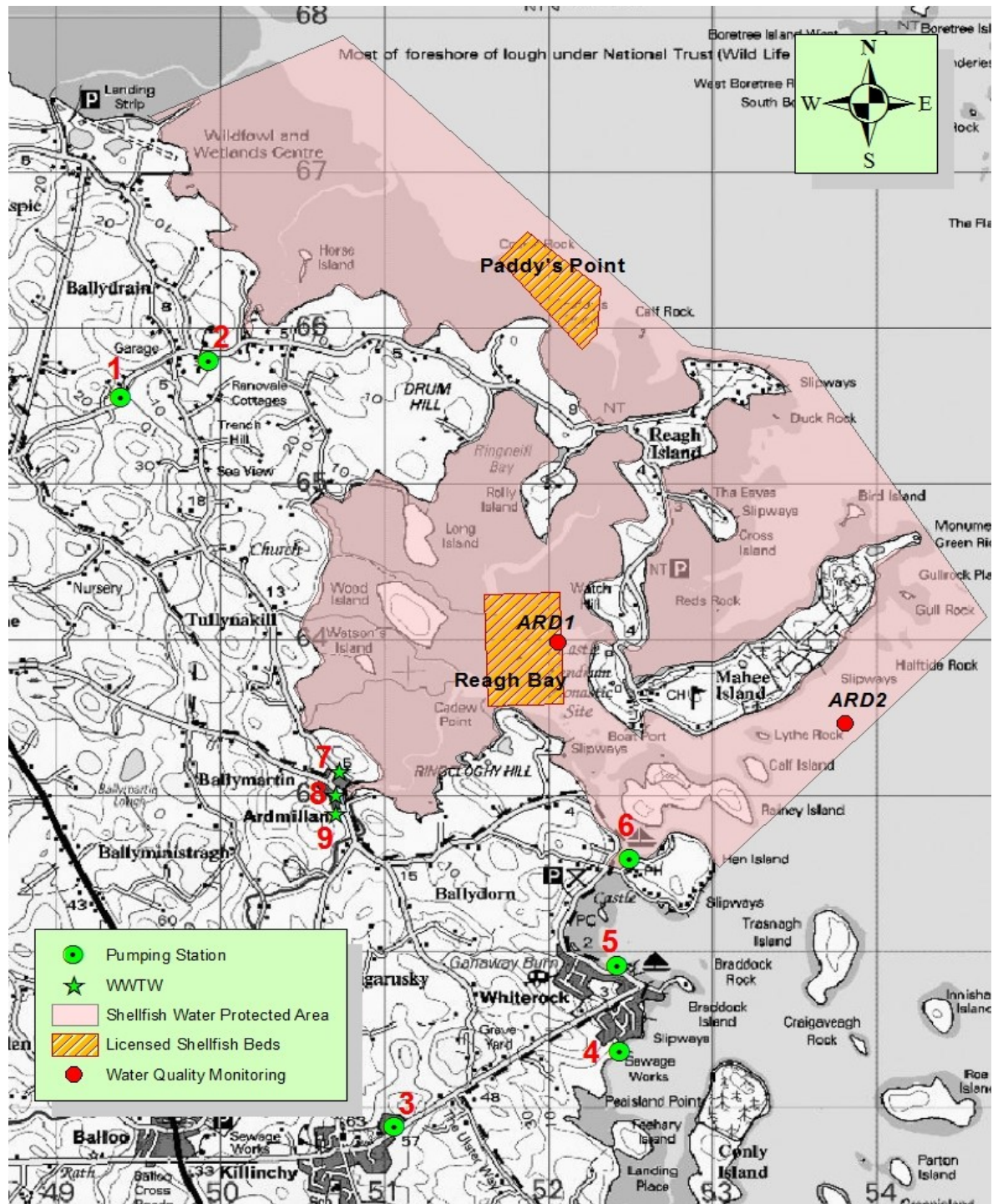
3: Killyleagh/Net Walk Combined Sewer Overflow

4: Seaview Combined Sewer Overflow

5: Killyleagh Wastewater Treatment Works

There are no point source discharges within 2km of Marlfield Bay Shellfish Water Protected Area

Figure 2. Licensed shellfish production areas in Paddy's Point/Reagh Bay, showing water sampling points, Shellfish Water Protected Area and potential point pollution sources.



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0 0.4 0.8 1.2 1.6
Kilometers

Key – Paddy’s Point and Reagh Bay

- 1: Ringneill Wastewater Pumping Station
- 2: Thornleigh Wastewater Pumping Station
- 3: Whiterock Rd Wastewater Pumping Station
- 4: Inisharoan Wastewater Pumping Station
- 5: Whiterock Wastewater Pumping Station
- 6: Sketrick Island Wasterwater Pumping Station
7. Tullynakill Wastewater Treatment Works
8. The Oyster yard Wastewater Treatment Works
9. Craigarusky Wastewater Treatment Works

5.0 Programme of Measures to Protect Shellfish Water Protected Areas

A North Eastern River Basin Management Plan was published in December 2009, identifying where the water environment needed to be protected or improved, the timeframe to make these improvements and how this could be achieved through a Programme of Measures.

Since this first Plan was published in 2009, the Department has been working with others to make improvements detailed within the Plan. Progress has been made and there are signs of improvement throughout the North Eastern River Basin District water environment. NIEA has updated the Programme of Measures taking into consideration existing measures and identifying new measures which are required to meet the objectives for 2021 and 2027.

A second North Eastern River Basin Management Plan was published in 2015 which builds on the positive work already being carried out. It details changes and new measures for the second river basin planning cycle 2015-2021. The Programme of Measures aims to address the key pressures through concentrated efforts targeted at the greatest threats to the water environment. From assessments conducted, two significant sources of pressure have been identified that are preventing water bodies from achieving good status in the North Eastern River Basin District. These are diffuse pressures and point source pressures from agricultural, urban wastewater and development.

A summary of some of the existing and planned measures is below. More detail can be found at <https://www.daera-ni.gov.uk/sites/default/files/publications/doe/water-report-north-eastern-river-basin-plan-2015.pdf>

<https://www.daera-ni.gov.uk/sites/default/files/publications/daera/NIEA%20-%20WFD%20Statistics%20Report%202018.pdf>

Key Sector – Agriculture – General

Specific actions for Strangford Lough are highlighted in the report card below.

Pressure Type – Diffuse and Point Source Pollution

Improvements required – Reduction in nutrient inputs and reduction in organic waste, reduction in pollution from sediment, education and awareness.

A **Memorandum of Understanding** has been signed between NIEA and the Ulster Farmers' Union. It is hoped that the MOU will assist in improving environmental outcomes, including improving water quality through addressing diffuse pollution.

One new incentive the Department has introduced is the **Environment Farming Scheme** (EFS). Launched in February 2017, this is a voluntary scheme that will support farmers and land managers to carry out environmentally beneficial farming practices on agricultural land. Agriculture pollution can have potentially damaging effects on rivers and shellfish growing waters. Many of our shellfish waters are in rural catchments and can therefore be susceptible to agricultural pollution. The scheme includes elements to improve and enhance water quality through both individual and group catchment improvement actions. Measures to improve water quality include buffer strips around rivers and riverine fencing.

The **Catchment Care Project**, which will be funded under INTERREG VA, will look at a range of agricultural issues across three catchments which have the potential to cause water pollution. The project will also examine measures to mitigate against water pollution impacts. The catchments are the Arney, Finn and Blackwater.

A **Strategic Agricultural Land Management Strategy** was launched by Minister McIlveen on 21st October 2016. Some of the recommendations within the Strategy are now being progressed by a pilot scheme in the Upper Bann catchment. A report on the effectiveness of the pilot, which will influence future management of agricultural land use incorporating better protection of waterways.

Although both the Catchment Care Project and the Strategic Land Management Strategy pilot are not within shellfish water catchments, the methodology and findings will be transferable to other sites.

Knowledge Advisory Service

A knowledge focussed service, managed by CAFRE which will deliver proactive programmes and drive innovation to improve the economic and environmental performance and resilience of the land based and food processing industries. Early indications are that interactions with the Knowledge Advisory Service and NIEA will help to provide advice to farmers on the linkages between their agricultural practices and impacts on water quality.

Compliance and Enforcement Visits – DAERA to enforce closed spreading period for slurries and application on land restrictions. Encourage and advise on good land management practices such as; riverbank fencing and riparian buffers.

Key Sector – Sewage and Industry – General.

Specific actions for Strangford Lough are highlighted in the report card below.

Pressure Type – Diffuse and Point source pollution

Improvements required – Reduction in pollution from sewage, reduction in nutrient and dangerous substances, reduction in pollution from unsewered properties, reduction in pollution from industry.

Actions – Northern Ireland Water Price Control (PC) process ensures investment in infrastructure. DAERA continue work on microbial source tracking to identify sources of bacterial contamination. Reviews of discharge consents on a catchment basis and comply with discharge standards in quality and quantity. Also improvements to existing controls on septic tanks, develop models and catchment based approaches to protect areas.

Key Sector – Urban Catchment

Pressure Type – Diffuse and point source pollution

Improvements required – Control of diffuse and point source pollution, reduction in pollution and flood risk,

Actions – Promote and adopt good practice with respect to storage, use and disposal of hazardous chemicals. Promote wider use of Sustainable Urban Drainage Systems (SuDs) and buffer strips.

The water environment in the North Eastern River Basin District is being managed at a local level through Local Management Area action plans, including the Strangford Lough Local Management Area action plan. In 2017 and 2018, activities have focussed on targeted catchments to best utilise resources.

Catchment Stakeholder groups provide forums for stakeholders to discuss water management issues in their local area and to work in partnership to address them.

Local Management Area Plan and 2013 update for Strangford Lough⁴

⁴ <https://www.daera-ni.gov.uk/publications/strangford-Lough-local-management-area-action-plan-and-update-2013>

6.0 Summary of Outputs (Expanded at Annex A)

Actions in Improving Sewerage Network and Waste Water Treatment Works
Monitoring and Investigations
Actions in Reducing Agricultural Inputs
Overall Management Actions

How much did we do #	How well did we do it %
Actions in improving Sewerage Network and Waste Water Treatment Works	
Sewerage network improvements in the Strangford Lough Area	Installation of Combined Sewer Overflow (CSO) monitors within 2km of identified Bathing Waters and Shellfish Water Protected Areas. NIW is currently carrying out a Drainage Area Study.
Upgrades to Wastewater Treatment Works (WWTW) since 2012	There have been no upgrades of WWTWs in this period
Monitoring and Investigations	
WFD classification (2015/21)	Strangford Lough North was at Moderate in 2015 and has a 2021 target of Good Strangford Lough South was Moderate in 2015 and also has a target of Moderate for 2021
Food Standards Agency <i>E. coli</i> in flesh programme (Annual Classification)	Full statistical analysis of the raw data is presented in Annex A
NIEA Pollution Investigations	Since 2012 the overall number of reported pollution investigations appears to be decreasing

Actions in Reducing Agricultural Inputs	
Inspection and enforcement of the NAP Regulations carried out by NIEA	Around 300 farm businesses annually assessed for compliance with the Nitrates Directive. Levels of non-compliance decreased in 2014-16, but increased in 2017 and 2018.
Overall Management Actions	
Statistical calculations using Seasonal Kendall test (SK test) were investigated for all data available from FSA E-coli monitoring programme.	This process is quality assured to the ISO9001:2008 standard.
<p>Is anyone better off as a result #/%</p> <p>It is not possible to measure temporal trends using shellfish flesh classifications alone. Full statistical analysis of raw data is required (See Annex A).</p> <p>Improving trends at S2 AFFNI 42 (Skate Rock) Mussels and S7 AFFNI 76 (Paddy's Point) Oysters.</p> <p>Overall a highly significant declining monotonic trend in E. coli was observed at S2 AFFNI 42 Mussels. When assessing trend by month significant declining monotonic trend was detected in February, March, April, May and July.</p> <p>Although overall it did not exhibit a significant declining monotonic trend, S7 AFFNI 76 Oysters showed a significant monthly declining monotonic trend in E. coli in September.</p> <p>Pollution investigations are carried out by Water Management Unit. Since 2012 there has been an overall decreasing trend in the number of reported pollution incidents, there were no confirmed high severity incidents within the time period.</p> <p>Overall WFD status for Strangford Lough North waterbody is Moderate (the 2021 classification objective is Good) and Strangford Lough South waterbody is Moderate (which is also its 2021 objective).</p> <p>Inspection and enforcement of the NAP Regulations is carried out by NIEA. Around 300 farm businesses are now selected for scheduled inspection each year and all are assessed for compliance with the Nitrates Directive. The levels of non-compliance were found to be reducing from 2014 to 2016. However in 2017 and 2018 the levels of non-compliance increased. NIEA</p>	

have increased the number of identified risk farms to visit in 2019 and will increase the number of inspections in selected priority water bodies this year.

Conclusion – Overall, Strangford continues to perform well. WFD status is moderate in both water bodies, with a 2021 objective of Good. Pollution incidents are reducing and whilst one site did not meet WFD Shellfish Guideline standards, there is an improving trend. DAERA will continue to monitor the area to ensure no significant deterioration of the Lough occurs.

Any incident should be reported to the NIEA Water Pollution Hotline on
0800 80 70 60



7.0 Further Information:

Further Information is available at:

www.daera-ni.gov.uk

Or by Emailing:

MarineDivision.InfoRequests@daera-ni.gov.uk

Annex A

Action/Output	Group	Completed, Ongoing or Planned
Upgrades to Sewerage Network		
Combined Sewer Overflow (CSO) monitor installation due to be completed by mid-2020. Pilot project completed 2018, to be rolled out to CSOs within 2km of identified bathing waters and Shellfish Water Protected Areas.	NI Water	Ongoing
Northern Ireland Water is currently carrying out a Drainage Area Study.	NI Water	Ongoing
Upgrades to Dundrum Wastewater Treatment Works		
There have been no upgrades in this period	NI Water	Ongoing
Monitoring and Investigations		
Strangford Lough has been divided into 2 waterbodies – Strangford Lough North and Strangford Lough South. Strangford Lough North was at Moderate in 2015 and has a 2021 target of Good – elements causing the Moderate classification are angiosperms, benthic invertebrates, hydromorphology and specific pollutants. Strangford Lough South was Moderate in 2015 and also has a target of Moderate for 2021 – elements causing Moderate classification are angiosperms, benthic invertebrates, hydromorphology and specific pollutants	DAERA	Ongoing
<p><i>E. coli</i> in shellfish flesh monthly Official Control monitoring and classification programme Increased knowledge and better understanding of what's happening in all the Catchments –</p> <p>It is not possible to measure temporal trends using FSA in NI shellfish flesh classifications alone. Full statistical analysis of raw data is required.</p> <p>Statistical calculations using Seasonal Mann-Kendall test (SM-K test). Using SM-K tests, it was found; (Period 2002-2018)</p> <ul style="list-style-type: none"> • Overall a highly significant declining monotonic trend in <i>E. coli</i> was observed at S2 AFFNI 42 Mussels. When assessing trend by month significant declining monotonic trend was detected in February, March, April, May and July. • Although overall it did not exhibit a significant declining monotonic trend, S7 AFFNI 76 Oysters showed a significant monthly declining monotonic trends in <i>E. coli</i> in September. 	FSA in NI	Ongoing

SM-K is a nonparametric test that analyses data for monotonic trends in seasonal data. It is the most popular trend test in environmental studies. “Monotonic” means a consistent upwards or downwards trend. “Seasonal” means that data is collected for periods where trends can be upwards or downwards. While it can refer to Spring, Summer etc., “seasonal” can also refer to other time periods, such as months. This will allow analysis of monthly trends over all the years’ data alongside an overall annual trend.

Pollution Investigations in the Strangford Lough catchments
breakdown by category

Pollution investigations continue to be carried out by Water Management Unit when possible pollution has been reported through the Emergency Pollution Hotline or identified by WMU staff. Since 2012 the overall number of pollution investigations appears to be decreasing. There were no high severity investigations in the time period.

	High	Medium	Low	Total Incidents
2012	0	2	17	19
2013	0	0	13	13
2014	0	2	4	6
2015	0	0	6	6
2016	0	0	8	8
2017	0	0	6	6
2018	0	0	3	3

DAERA – Water Management Unit

Ongoing

Actions In Reducing Agricultural Inputs

Inspection and enforcement of the NAP Regulations is carried out by NIEA. Around 300 farm businesses are now selected for scheduled inspection each year and all are assessed for compliance with the Nitrates Directive. **The levels of non-compliance were found to be reducing from 2014 to 2016. However in 2017 the levels of non-compliance increased and the same increased level of**

Water Management Unit

Ongoing

<p>non-compliance was found in 2018. The main non-compliances found over the period were nitrate pollution and defective effluent storage, with N loading in 2017 and spreading issues last year due to the exceptionally wet winter in 2017-2018.</p>		
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Annex B

Contaminants in shellfish flesh monitored by DAERA and FSA in NI

Metals	Polycyclic aromatic Hydrocarbons
Arsenic	Naphthalene
Silver	Phenanthrene
Cadmium	Anthracene
Chromium	Fluoranthene
Copper	Pyrene
Iron	Benzo (a) Anthracene
Mercury	Chrysene
Nickel	5 Methyl Chrysene
Lead	Benzo (b) Fluoranthene
Zinc	Benzo (k) Fluoranthene
Selenium	Benzo (j) Fluoranthene
	Benzo (c) Fluorene
	Benzo (a) Pyrene
	Indeno (123,cd) Pyrene
	Dibenzo (a,h) Anthracene
	Benzo (ghi) Perylene
	Dibenzo (a,l) Pyrene
	Dibenzo (a,e) Pyrene
	Dibenzo (a,i) Pyrene
	Dibenzo (a,h) Pyrene
	Cylcopenta (c,d) Pyrene

Polychlorinated Biphenyls
PCB 28
PCB 52
PCB 101
PCB 118
PCB 138
PCB 153
PCB 180

Dibenzo-p-dioxins (PCDDs)
2,3,7,8-TCDD
1,2,3,7,8-PeCDD
1,2,3,4,7,8-HxCDD

1,2,3,6,7,8-HxCDD
1,2,3,7,8,9-HxCDD
1,2,3,4,6,7,8-HpCDD
OCDD

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